REMARKS

I. PENDING CLAIMS AND SUPPORT FOR AMENDMENTS

Upon entry of this amendment, claims 1-16 will be pending in this application.

Support for the amendment to claim 1 can be found in the specification at page 5, lines 18-19. No new matter has been added.

II. ANTICIPATION REJECTION OVER YANG ET AL.

In paragraph 2 of the Office action, the Examiner has rejected claims 1-10 and 14-16 under 35 U.S.C. § 102(e) over Yang et al. (U.S. Patent No. 6,036,726). Applicant respectfully traverses this rejection and requests reconsideration and withdrawal thereof.

Applicant respectfully submits that Yang et al. does not anticipate the rejected claims at least because the Yang et al. process does not operate at a pressure higher than the vapor pressure of the solvent at the solvation temperature.

Yang et al. is directed to a process of decolorizing nylon, and as such, discloses numerous process steps different from those required for nylon recovery from waste materials. These steps include, for example, contacting the dissolved nylon with "active" decolorizing agents, such as bases added to precipitate acid dyes. In addition, Yang et al. is concerned with recovery of the dyestuff molecules for reuse. In light of these significant differences in purpose between the decolorizing process of Yang et al. and the nylon recovery process of Applicant's claims, it is hardly surprising that other differences between the processes exist.

One such difference is that the Yang et al. decolorization process dissolves nylon using a pressure equal to the vapor pressure of the dissolution solvent at the

dissolution temperature. *See* column 6, lines 56-58, which states "The pressure at which the solvating step is carried out will depend upon the solvent since the pressure is the result of the solvent vapor pressure." By contrast, as claim 1 recites, Applicant's method for recovering nylon includes contacting the waste material with solvent at a pressure higher than the equilibrium pressure of the solvent at the contacting temperature.

The Examiner implicitly recognizes this distinction by not rejecting claim 12 as anticipated by Yang et al. Claim 12 recites that the elevated dissolution pressure is achieved by pressurizing the reactor vessel with an inert gas. However, it is not merely the use of an inert gas that distinguishes the claimed process from that disclosed by Yang et al. but the use of increased pressure achieved by any means. For this reason alone, none of the claims are anticipated by Yang et al., which fails to disclose every element recited in the claims, namely, the use of a dissolution pressure above that of the equilibrium vapor pressure of the solvent. Applicant respectfully submits that this rejection should be withdrawn.

III. OBVIOUSNESS REJECTIONS

A. YANG ET AL. IN VIEW OF MEYER

In paragraph 5 of the Office action, the Examiner has rejected claims 10 and 11 under 35 U.S.C. § 103(a) as obvious over Yang et al. in view of Meyer (U.S. Patent No. 4,334,056). Applicant respectfully traverses this rejection and requests reconsideration and withdrawal thereof.

First, as described above, Yang et al. fails to disclose using a dissolution pressure higher than the equilibrium vapor pressure of the solvent, as recited in

Applicant's claims. Moreover, Yang et al. fails to suggest such a modification, and in fact teaches away from increasing pressure above this point by explicitly stating that the pressure in the Yang et al. system is the result of the vapor pressure of the solvent. Meyer fails to teach any such modification as well, and so fails to cure the deficiencies of Yang et al. described above. For this reason alone, the Examiner has failed to establish a prima facie case of obviousness, and should withdraw this rejection.

In addition, Meyer is specifically concerned with depositing on a metal substrate a polymer coating containing polyamides of at least 10 carbon atoms per carbonamide group. While Meyer mentions other polymers, such as nylon 6 and nylon 6,6, these are mentioned in passing as other nylons that might be included in minor amounts (less than 30 wt%) with the C10 polyamides. Meyer is not concerned with recycling waste material. To the contrary, Meyer teaches away from any such recycling by placing such a low limit on the amount of nylon 6 or nylon 6,6 that may be allowed. This is not surprising, since the very application to which Meyer puts his dissolved nylon (i.e., coating very small particles of metal) indicates a need for relatively high purity feedstocks, which would render the use of recycled waste nylon undesirable. As a result, there is no motivation to combine the teachings of Meyer with those of Yang et al.

Even if the reference teachings were combined in the manner suggested by the Examiner, the claimed invention would not be obtained. The temperature ranges taught by Meyer are for the dissolution of C10 polyamides, or mixtures of C10 polyamides, rather than for dissolving nylons. Thus, if the reference teachings were

combined, one of ordinary skill in the art would expect to have to modify the feedstock of the Yang et al. process to incorporate C10 polyamides in order to make use of the Meyer temperature range. However, the long chain copolyamides used by Meyer will not have the level of crystallinity necessary for effective use in making polyamide fiber. The number of amide groups present in such copolyamides is much lower than for conventional nylons, resulting in lower amounts of hydrogen bonding and decreased crystallinity. Their use in the process of Yang et al. (assuming that this could even be made to work) would not result in a material suitable for formation into nylon fiber. As the Examiner is no doubt aware from reading the specification of Applicant's application, one of the major advantages to Applicant's process is the ability to recycle nylon without degradation of its properties, thereby providing improved sustainability: waste nylon fiber is recycled for an equally high valued use, not simply recycled for a lower valued use in, e.g., injection molding.

B. YANG ET AL. IN VIEW OF BOOIJ ET AL.

In paragraph 6 of the Office action, the Examiner has rejected claims 10 and 11 as obvious under 35 U.S.C. § 103(a) over Yang et al. in view of Booij et al. (U.S. Patent No. 5,840,773). Applicant respectfully traverses this rejection and requests reconsideration and withdrawal thereof.

First, Applicant notes that the statement of rejection is confusing, since it identifies Yang et al. as the primary reference, while the body of the rejection refers to Meyer. Applicant assumes that this is a typographical error, and that the statement of rejection and the Examiner's rationale should both refer to Yang et al. (otherwise,

the rejection is improper under the rationale articulated in *In re Hoch*, 166 USPQ 406 (CCPA 1970)).

Second, Booij et al. does not cure the deficiencies of Yang et al. noted above. In particular, at column 5, lines 5-15, Booij et al. indicate that the pressure used for the extraction is not particularly important, and can desirably be the vapor pressure of the solvent at the extraction temperature – precisely the method suggested in Yang et al. Thus, even if the disclosure of Booij et al. were combined with that of Yang et al., the claimed invention would not be obtained.

Because the Examiner has failed to establish a prima facie case of obviousness, the rejection should be withdrawn.

C. YANG ET AL. IN VIEW OF STOTT ET AL.

In paragraph 7 of the Office action, the Examiner has rejected claims 12 and 13 as obvious under 35 U.S.C. § 103(a) over Yang et al. in view of Stott et al. (U.S. Patent No. 2,742,440). Applicant respectfully traverses this rejection and requests reconsideration and withdrawal thereof.

Even if the teachings of Yang et al. are combined with those of Stott et al. in the manner suggested by the Examiner, the claimed invention would not be obtained. Stott et al. use temperatures ranging from 160 °C to 190 °C to dissolve nylon in a solvent. This corresponds closely to the disclosure in Yang et al. that the solvating step temperature should range from 160 °C to 180 °C. Thus, combining the teachings of Stott et al. with those of Yang et al. would lead one of ordinary skill in the art to use the preferred range of Yang et al., since this range corresponds to that of Stott et al.

However, such a temperature range is higher than that recited in the claimed process. In fact, these higher temperatures will cause degradation of the nylon at the residence times described in Yang et al. Even if this degradation does not cause any obvious problems with the precipitated nylon (because the degraded, lower molecular weight nylon will remain in solution unless fractionally crystallized), it will reduce the yield thereof. However, neither Yang et al. nor Stott et al. indicate that any nylon produced from a fiber feedstock would retain its molecular weight to a degree sufficient to make it suitable for re-spinning into nylon fiber. To the contrary, both processes seem to be limited to producing nylon for use in injection molding applications. In effect, the nylon produced has been downgraded in value as the result of the process.

By contrast, Applicant has found that nylon can be dissolved and precipitated using lower temperatures and higher pressures, such that even at substantial residence times and nylon concentrations, the resulting precipitated nylon retains its molecular weight sufficiently to produce economical quantities of product of suitable quality for spinning into fiber.

In each of the references cited by the Examiner, relatively high temperatures are used for relatively long dissolution times (on the order of 20 minutes to 1 hour, or more). Applicant has found that, by using a higher pressure than suggested in the prior art, a short dissolution time can be used at a lower dissolution temperature. This is significant: the long dissolution times of the prior art processes lend themselves to batch processing, not continuous processing. Batch processing is problematic because it is economically undesirable, and because the longer residence times and

batch conditions allow for contamination of the resulting nylon with other soluble polymers.

By using a higher pressure dissolution process, Applicant has shortened the necessary residence time when the recycled nylon is in contact with the solvent, and allowed the process to be conducted in a continuous manner. The continuous process requires much less manpower to operate than the corresponding batch process, and allows the use of more automation in the downstream processing of the resulting nylon.

In addition, the use of short residence times in a continuous process provides for more efficient separation of the nylon from other components in the mixture, including lower molecular weight polymers, such as degraded nylon, or other, higher molecular weight contaminant polymers, such as polyester or polypropylene, adhesives, and the like. A short residence time at high pressure allows dissolution of the desired nylon without significant dissolution of other polymers, e.g., from backing materials.

Without wishing to be bound by any theory, Applicant believes that the higher pressure of the claimed process allows the solvent to more effectively interfere with the hydrogen bonding that holds the nylon polymer chains together, allowing the nylon to dissolve at a rate that might be expected for polymers having a lower molecular weight than the nylon. Because of the faster, cleaner dissolution obtained with the high pressure process of the invention, fiber properties for nylon prepared in this manner are better than those obtained from fiberizing virgin nylon. For example, fiber made from 100% nylon recycled according to the claimed process possessed

tenacities of around 3.9 g/denier. Fiber made from a blend of 50% virgin nylon and 50% nylon obtained by the claimed invention had tenacities of around 3.5 g/denier. Tenacities for 100% virgin nylon fibers is generally about 2.7 to about 3.2 g/denier. Applicant believes that this improvement in properties is due to the removal of contaminants, such as lower molecular weight nylon, present in higher quantities in virgin nylon.

MARKED UP COPY OF AMENDED CLAIMS

1. (Amended) A method for recovering nylon from a nylon-containing material, comprising:

contacting the nylon-containing material with an alkanol-containing solvent at elevated temperature <u>that is below 160 °C</u> and at a pressure higher than the equilibrium pressure of the alkanol-containing solvent at the elevated temperature, thereby dissolving the nylon in the alkanol-containing solvent;

removing the alkanol-containing solvent containing dissolved nylon from any undissolved solids; and

decreasing the temperature of the alkanol-containing solvent containing dissolved nylon to precipitate the dissolved nylon.

Applicant respectfully submits that the claims are in condition for immediate allowance, and an early notification thereof is earnestly solicited. If the Examiner has any questions, or if further issues remain to be resolved, the Examiner is respectfully requested to contact the undersigned at 404.815.6218 prior to issuance of any final Office action.

The Commissioner is hereby authorized to charge any deficiencies or credit any overpayment to Deposit Order Account No. 11-0855.

Respectfully submitted,

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